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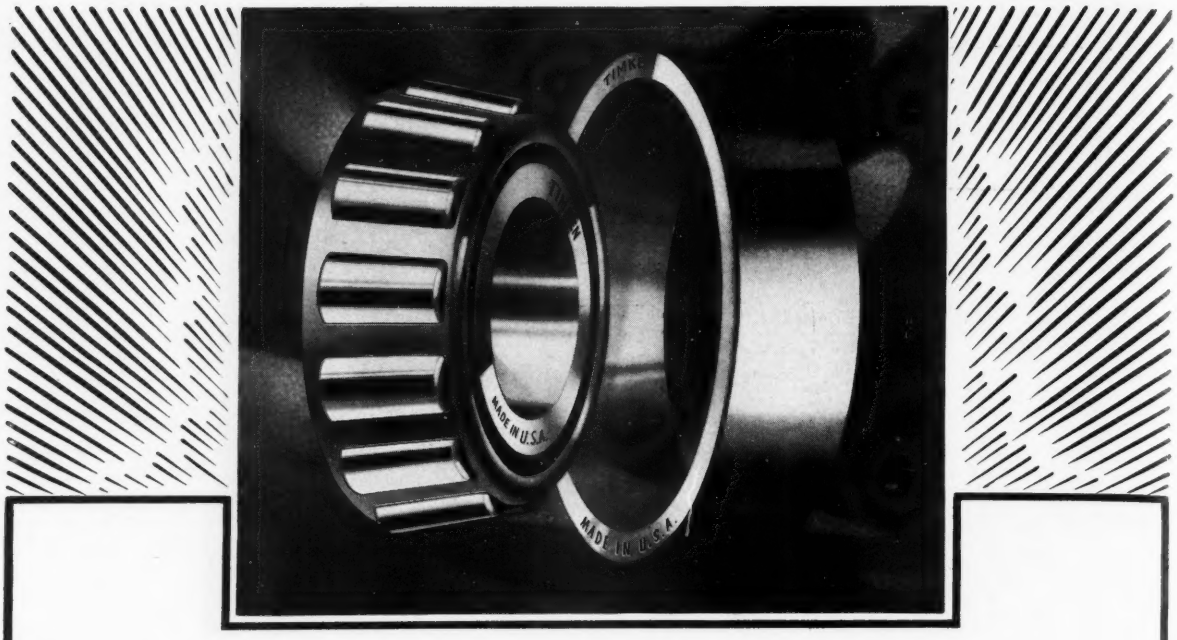

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Editor's Column

How could a glass bowl affect the lives of college students? A few weeks ago in Washington numbers were drawn, out of such a glass bowl, that affected every young man in the country of twenty-one years of age and over. Many of our students, particularly the seniors, have been rather anxious to see in what order their draft numbers were drawn. How can the government justify taking college men, especially the engineers, who are considered as men trained in certain professions, out of these trained professions and putting them in the army or in work for the government where their special training will be of little value to them? This question is best answered by a statement Dean Hollister picked up from one of our alumni.

It is much better for a trained man to spend a few years now working for the government perhaps not in his chosen field than for him to continue working in his chosen field for a few years and have to stop work altogether.

We want to call your attention to the article by J. Carlton Ward as told to the editors. It is the first time that any information from the American Mission to France has been published. We wish Mr. Ward could deliver his message to each of you personally the way he told it to us.

We can't resist the temptation to tell this one on Jack Moynihan. It seems that one morning last fall he drove to work as usual parking his car behind Sibley. At noon Miss Page, the secretary in the employment office, found him across the campus bumming his way back to his office. In the afternoon he walked to the golf course and played his usual round of golf after which he called home and left word for his wife to drive out to the club and pick him up. He waited an unusual length of time for his wife only to have the pro tell him that his wife had called and said that he took the car with him in the morning. He had to pay the price of walking back to Sibley to pick up his car. We hereby recommend Jack Moynihan as having qualified for the title of absent minded professor.

Next month we expect to bring to you a timely article on employment, a subject foremost in every seniors mind. Dr. Adams will explain the new extension school in Buffalo run by the University, and another interesting student article will be printed. We will present a "double exposure" meaning Fred and Jack Hillsley, twins, and two of the outstanding men in the A.E. class. Even after four years of college with the boys we still have trouble telling them apart. We will also bring you the man behind the scenes in Cornell's new wired network, Bob Meacham. Another personality will be Warner Lansing one of our prominent C.E.'s.

We are starting off the new year in a big way. Don't miss our January issue.

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—Courtesy Esso Marketers

AN OIL WELL BEING MADE READY FOR DRILLING OPERATIONS

France Prepared --- Too Late

Observations on the Industrial Preparedness of France

By J. CARLTON WARD, JR., M.E. '14

President, Fairchild Engine and Aircraft Corporation

As told to the editors

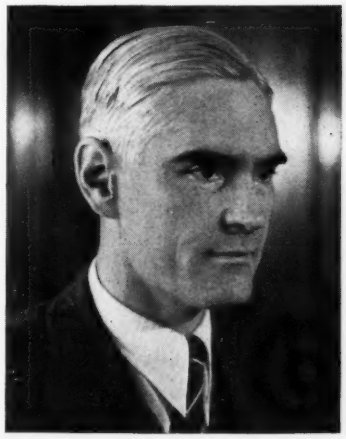
Those who were fortunate enough to hear one of the addresses given by J. Carlton Ward, Jr. on October 25 in West Sibley will not forget his memorable message that day. With Mr. Ward's most-welcomed cooperation, the editors have attempted to capture permanently, and for the first time are printing in this form, some of the thrilling accounts of his observations and experiences which he made while in France this past year. He was one of the five-man, General Motors-sponsored American Mission to France, which, on the invitation of the French Government, was formed and sent to France in May, 1940, to study her industrial problems.

FRANCE collapsed. The fact that it did surrender is now a well known and accepted truth; the reasons given as effecting the result were many and varied. Some newspaper accounts have placed the blame upon poor industrial production. The downfall of France may be, in brief, attributed to two causes: (1) she started to prepare too late; (2) she underestimated the enemy.

The Political Situation In France

Prior to the World War II, under the Front Populaire, which was distinctly a Labor and Leftist dominated government, the French aircraft industry, among others, was nationalized to such an extent that production was reduced to a low level. The reasons for this were, in a large measure, the bureaucratic and political control of management, accompanied by liberal labor practices and the forty-hour week. There were, for example, plants in which many of the functions of management were taken over by labor, others in which the politics were such that workers were required to possess a Communist party card. With one important exception, the aircraft engine industry was not subject to government nationalization, because of the threats of ownership and management to walk out.

The Front Populaire, under Leon Blum, bowed out, leaving the industrial machine of France in a sad state. When Daladier came into office, as Premier, he brought with him as the Air Minister, Guy La Chambre, who was given the job of rebuilding the airplane industry. After War was declared, the forty-hour week was dropped; production rose rapidly as the men, working on twelve-hour shifts, and the women on eight-hour shifts, intensified the upswing. France was doing everything in her power to raise the country's industrial output. She was in this state when she invited a mission from the



United States to visit her aircraft engine plants and study her problems and methods.

Observed Conditions In France

The Mission made its first visit to the one aircraft engine factory that had been nationalized by the government. It was significant that this factory had the poorest output of all the aircraft engine plants in France. Under the Blum government, production in this factory, with 3200 employees, averaged 25 engines a month. Under the Daladier and Reynaud governments, this production rose to over 100 engines a month, with fewer employees and despite the fact that hundreds of women had been substituted for men, because of the requirements of the Army. The plant management had estimated that within the next four or five months production should rise to 150 engines per month, but agreed with the American Mission that when normal production criteria were applied to the floor space and the number of workers, 200 engines a month would be a reasonable output.

The Mission had the opportunity to visit the Ford plant, also in the Paris district, which was as clean, as neat, and as fine a plant as any in this country. At this time the bombing of Paris had taken place and it was apparent that the factory operations would have to be abandoned and removed to the southwestern portion of France. It was interesting to note that some returning German bombers had dumped their remaining load in the vicinity of the Ford plant and had put its power lines out of operation. Fortunately, however, the factory had a standby Diesel plant and was able to continue in production, thus emphasizing the importance of two sources of power to factories subject to bombing.

Subsequent to the bombing, the great Hispano Suiza factory, located in Paris, was immediately moved to an ancient quarry, founded in the Tenth Century. The quarry was located north of Paris a few miles and underlay an agricultural area devoted to truck gardening. Upon our inspection of this operation, nine days after the bombing, we found thousands of workers underground carrying on precision manufacturing of airplane engine parts. From the air there was no evidence of any activity, and the ceiling of the quarry was approximately sixty feet under the top soil, forming complete protection from the largest size bombs. The French had shown unusual ability to work fast and they had efficiently changed over the under-

ground chambers into well lighted areas, with electric trucks moving material, office and inspection areas for controlling protection, and the like.

Bombs Dropped By The Germans

In order to instill confidence and raise the morale of her people, as well as to express its appreciation to the American Mission, the French government decided to fete the American Mission with a luncheon to be given by the Air Minister and his staff, the time and place being announced over the radio. Arriving at the Air Ministry on the appointed hour of 1:15 P.M., we were carried by the elevator to the sixth floor, where the French officials and Ambassador Bullitt were expecting us. Up to this time the Germans, apparently dreading reprisals on their own cities, had carefully avoided widespread bombings of non-military objectives, but the elite gathering of high French officials and the American Mission seemed to present too excellent an opportunity to resist. At 1:18 P. M. the air raid alarm sounded. This was followed at 1:24 P. M. by the whine of the bombs as they rained down from overhead. The realism became only too evident when a large bomb plunged through the five-story building across the square, exploding the entire building into the street. The next missile landed in an air field, throwing dirt to a height of seven stories, high above our heads. The mass of dirt, as it was rocketed into the air, took the form of a Grecian mortuary urn, to us symbolic of death. We later learned that, amid the rain of falling bombs, the driver of our car, which as it happened, was one of the few not demolished by the exploding bombs, had summoned the courage to drive to the hospital a man whose legs had been blown off by a bomb that had landed in a nearby shed and killed two fellow workers.

In the course of the duties of the Mission, we were permitted to witness at first hand the operation of some of the aircraft units from the areas immediately behind the lines. We were able to discuss with combat officers the operation and relative efficiency of the various pieces of equipment.

A Martin Bomber Ready for the Takeoff

The Secret of the Messerschmidt 109

Propanganda sources had convinced U. S. Army officials that the Curtiss plane, powered by a Pratt and Whitney twin-wasp motor, would be ineffectual in the presence of the high-speed Messerschmidt 109's. Accordingly, the U. S. Army had released American production of these planes to France, and it was discovered that the plane was actually superior to those in use during the early stages of the War in Europe. It does seem rather paradoxical that the relatively slow, 308 m.p.h. Curtiss ship should blast the powerful 469 m.p.h. Messerschmidt out of the skies. The truth of the matter is that in order for the Messerschmidt to possess the high-speed rating, the plane used in the test was stripped of all guns and otherwise lightened and smoothed up. The pilot then dove it from a high altitude to attain the maximum feasible speed before leveling off, raced it over the three-mile course and back. It was also understood that the engine had been altered in such a way as largely to eliminate the cooling drag, with the result that it could operate only for a period of short duration under these conditions.

Its downfall is attributable to its lack of maneuverability, also resulting in its inability to make a left turn in the air. French flyers took advantage of these deficiencies and were able to work out tactics in the air which capitalized on the shortcomings of the Messerschmidt design and overcame the disadvantage in speed, which was stated to be in the order of 308 m.p.h., as compared with 330 m.p.h., the latter being the true speed of the Messerschmidt in fighting condition. Thus, under ordinary circumstances, the original Messerschmidt 109, when loaded, is quite a bit slower than one had been led to believe.

It was also interesting to note that the American attack bombers, which were being put into the front line at approximately this time, were deficient in not having bullet-proof self-sealing gasoline tanks and in having exhaust collectors which betrayed the ship's position in night maneuvers, by permitting the exhaust to be visible. Improvements of this character can only be brought about in aircraft design by experience in war conditions, which in the past had not been applied to American equipment.

Our stay in Paris was terminated with the approaching German occupation of that city, but our visits continued throughout France to many other plants, many of them dubbed "shadow plants"—in other words, those financed by the government, yet privately operated. In the Gnome-Rhone production setup the French government originally planned to specialize on the manufacture of certain engine parts in each distinct factory unit. This plan was abandoned when it became clear that bombing could put any one of these factories out of production and, in consequence, the product of all would be put out of commission by inability to assemble any engines. As soon as the mistake was discovered, the French authorities moved with amazing speed and, in one instance, 700 machines were moved in a week's time and reinstalled in one of these units, converting it from a cylinder factory to the manufacture of a complete set of engine parts.

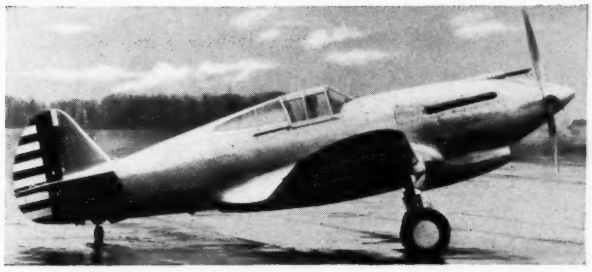
Examples of French Resourcefulness

The creation of these entire plants involved tremendous problems, not only in engineering, but

also in personnel, in the locating and handling of thousands of workers and their families. It is staggering just to think of the housing, medical and feeding difficulties that challenged progress. As an example, French resourcefulness, however, was well characterized in the building of the "City in the Pines" at Le Mans, France. Requiring 1500 homes to house workmen to supply the labor for nearby airplane engine factories, the French, as much as they dislike regimentation, decided upon only four basically different housing designs. They provided each design so that any side of the house could be presented to the street, thus producing four distinct fronts. By painting the houses four different colors, they, in effect, brought the total number of combinations to sixty-four. The effect of mass production of the houses was consequently avoided by arranging them in different combinations along the streets, which were purposely curved to break up the monotony of long lines of houses.

By far the most unusual factory that we saw in France, outside of the underground quarry, was a bomb-proof structure, nearly completed, and near the City in the Pines. It consisted of a heavily-reinforced concrete shell, whose cross-section was shaped in a capital "D" with the flat part of the "D" horizontal, forming the base. This shell was a little more than six feet thick of heavily reinforced concrete and was designed to withstand the direct hit of a 2000 pound bomb. Entirely separate was the structure within, a complete four-story factory covering half a million square feet of area. It was constructed so that it did not touch the sides of the shell at any point and was completely air-conditioned and windowless, with one door for entrance. The outer shell, overlain with top soil, which, in turn, was given to planting, had a typical country road meandering across its top. A railroad siding, leading into the sole entrance to the hill and factory, wound around the countryside and completed the near-perfect camouflage.

The extent to which France went to industrialize in order to try a last-minute futile attempt at meeting the Germans' terrific pace is illustrated by their turnng a pickle and conserve plant in southern France into a modern aircraft engine maintenance plant. In many respects the French were doing things that we would have said were hardly possible. They made one fundamental mistake, however, in allowing their skilled laborers to be drafted into the Army. Factories, temporarily crippled by a shortage in skilled men workers, resorted to women and children to keep heavy machinery in operation. Even in foundries women were performing operations never before attempted by them. In another case we found a fourteen-year-old youngster standing on a box in order that he might reach the levers on a machine tool. Nevertheless, despite the hardships, the French worker maintained an unusually high morale.



Latest View of Allison-Powered Curtis P40 Pursuit
—Courtesy Aero Digest

Although we found that her difficulties were increased because of the fact that raw materials and tooling were inferior to the standards in this country, we must emphasize the truth that France was not as backward in the production of airplane engines as we had been led to believe, when compared with our production at that time. She had planned, in fact, to have an output of 3200 engines a month by the first of 1941, had she not lost the War. The 3200 were to consist of 1100 to 1200 of the Hispano-Suiza liquid-cooled, and 2000 to 2100 of the Gnome-Rhone air-cooled type.

Electrically Operated Cut-away Model of the 1100 H.P. Wright Cyclone Engine.
—Courtesy Aero Digest

Lessons To Be Learned

It has been said, and quite aptly, that England and America, idealistically peaceful, prepared for no war at all; France prepared for the War of 1914 all over again; and Germany prepared for seven years for this War of 1940, at a total cost which economists have theorized to be thirty-nine billions of dollars. This War of 1940 was planned by the Germans to be a "war of mass," involving tremendous reserves of supplies and a vast amount of mechanical equipment, which bore an overwhelming ratio of five to one to that of the French.

America still has a great deal to learn.

She has not had the actual war experience to prove the effectiveness of her weapons or to educate her personnel in practical combat.

She has much to learn, not only from the mistakes of the French, but also from certain technical developments observed in the French production facilities.

The most important fact that America must realize, however, is that in modern warfare it is far more difficult and also that it requires a longer time to prepare industrially behind the lines than it does to train combatant units.

France found this out—too late.

Gelatin Photoelastic Models

By DR. T. R. CUYKENDALL

IT IS well known that the photoelastic method for the determination of stresses in a loaded member depends upon the fact that certain transparent materials become bi-refringent when stressed, the degree of the bi-refringence being proportional to the value of the stress. The polariscope serves to measure the bi-refringence, and thus the stress, usually by means of dark or colored lines which appear on an image of the loaded model. Such lines, called iso-chromatics, are contours of equal shearing stress values and are comparable with elevation contours on a survey map. A high degree of bi-refringence under stress is shown by ordinary gelatin, whose stress-optical properties were studied many years ago.[1] Although the physical (or more exactly, the mechanical) properties of this material are such as to make unsatisfactory its use in general photoelastic analysis, there are some types of studies in which gelatin forms a desirable model material. This article describes a few such uses, and further proposes that gelatin offers to science clubs or similar groups certain advantages as a model material for purely qualitative demonstrations.

The elastic properties of gelatin are of practical importance industrially because its value for printing rollers, adhesives, photographic films, etc., depends upon these properties. In recent years colloidal gels, of which gelatin is an example, have been studied extensively, particularly by chemists.[2] Because the proper interpretation of the photoelastic effect depends upon certain relations between the mechanical and optical properties, a short review of the nature and structure of gelatin may be of interest.

Gelatin and glue are colloidal organic substances known as proteins, and are derived from collogen, a component of the skin and bones of animals. A fundamental characteristic of such proteins is that the particles are giant, chain-like molecules consisting of thousands of atoms. In gelatin the particles are usually non-oriented, as distinguished from wool, silk, or muscles in which ordered particles are usually present. The molecules may carry positive or negative charges on their surfaces. Since some of these groups may change sign by a change in hydrogen-ion concentration (acidity or pH value) and thereby repulse groups which they formerly attracted, the pH value has an unusually great influence on the physical properties.[3] It has been suggested in some cases that at the iso-electric point the chains may be coiled up, whereas for other pH values they are stretched out. This is then one argument for cleanliness in handling the gelatin melt. The long, sometimes spiralized, chains show one important difference from those of cellulose, namely, they are much less rigid. It is generally accepted that the assumed gelatin chains may arrange themselves in a more or less completely crystalline lattice. In this way crystalline micelles or crystallites may be formed. At the ends of these is a finger-like formation joining the one micelle with a second micelle. Thus a deformable network is formed in which the micelles are the rigid parts and the fringes the moving parts. While the micelles themselves may have a definitely regular structure, the connections to one another through the fringes are entirely at random; hence, the framework is not symmetrical.

This structure, if oriented, perhaps by a proper mechanical manipulation, would give an X-ray fiber diagram. Such diagrams have been observed. A more severe manipulation may break up the structure sufficiently to decrease greatly the "rigidity" of the gel. Continued boiling or heating of the gelatin melt also serves to break up the structure and the gelatin becomes "hydrolized" and will not set. It has been shown that gelatin is able to take up to 50% of water within the crystallite, resulting in a continuous increase in the distance between the chains. Additional water goes around and between the crystallites. This water evaporates from the exposed surface region, causing it to shrink and crack severely in from a few hours to a day, depending upon local conditions. A wet cloth on a framework over the model provides a saturated atmosphere which markedly prolongs the time before shrinkage becomes serious. I have observed a shrinkage of 15% in linear dimensions when a cube of 12% concentration was stored for 6 days at 40°F. in a refrigerator. The problem of water absorption and swelling will be discussed later.

Literature on the physical (or more exactly, the mechanical) properties of gelatin gives only a scattered discontinuous picture of these properties. Experimental

Dr. Cuykendall, having earned his B.S.E.E. and M.S. in Physics degrees at the University of Denver entered the Graduate School at Cornell in 1929. He had previously served as an instructor at his Alma Mater from 1927 to 1929 in Engineering Mathematics. During his period of instructorship in Physics at Cornell from 1930 to 1936 he worked for his Doctor's degree, which he obtained in 1935. He joined the School of Civil Engineering in 1936, performing research. In the spring of 1940 he was appointed Assistant Professor of Civil Engineering.

1. *Treatise on Photoelasticity,* Cover and Filon, Cambridge.
2. *Glue and Gelation,* Alexander, Chemical Catalogue Co.
   Elastic Properties of Gels; Bogue, J. Am. Chem. Society XLIV, 1313 (1922); Busse, J. Phys. Chem. XXXII, 2663 (1932)
3. *Kolloidzeitschrift,* Merckel, J. H. C., LXXVIII, 41, 339 (1937)

data for stress-strain diagrams for gels of different concentrations, at various temperatures, and pH values, are not available. Such diagrams, although of considerable value, would be difficult to obtain, for reasons which will be apparent in the following.

The two most important physical factors of gelatin are the "bloom" (a measure of jelly strength), and the viscosity. Each of the two factors is appreciably affected by any physical or mechanical manipulation of the gel or solution, which always results in a loss of elastic properties. Time and temperature of the solution also determine the rate of hydrolization, and, therefore, loss of gel strength. Each time the gelatin is "set" and remelted a loss results. Thus the physical properties determined in any given experiment will be affected by the time in solution, and by the mechanical manipulation of that given batch.

Shepard and Sweet[4] found that for jellies with concentrations between 8% and 34% Hooke's law is applicable nearly up to the breaking point. More recent work shows that the stress-strain diagram has a point of inflection—a matter of importance in connection with the structure of the material. An empirical relationship between the modulus of elasticity E, and the concentration C, is

$E=KC^*$, n « 2 usually. K and * are constants depending upon grade of material, decomposition, time since setting. Typical value of D is

E=14 lbs./sq. in. for 18% concentration.

It has been found that E varies with pH value, being greatest at the isoelectric point. The temperature has a definite effect on the shape of the elastic curve. Curves for gels at temperatures over 34°C. show no yield value. The Poisson ratio is reported to be 0.5.

As indicated hereto, the physical properties are greatly influenced by impurities, especially the salts of heavy metals. One such salt, Barium Iodide, if added to the solution, might increase the density of the gel so as to enhance the gravity forces therein. Unfortunately, this salt, although the one most likely to be successful, also hydrolized the gel so that it did not "set" firm. However, pure glycerine, about 10%, added to the solution, tends to give a tougher, more elastic gel.

The stress optical coefficient of various gelatin samples has been found to vary from 8,000 to 20,000 Brewsters, the tendency being to increase with increasing concentration. The coefficient also varies with temperature, impurities, and time after setting. The fringe value, usually expressed as the stress necessary to produce one isochromatic contour in a specimen one inch thick, is of the order of 0.1 p.s.i/inch as compared with 80 p.s.i./in. and 230 p.s.i/in. for Bakelite and celluloid respectively. Thus it is seen that gelatin has a relatively low modulus and a very high optical sensitivity.

In one calibration specimen (12% concentration) I observed

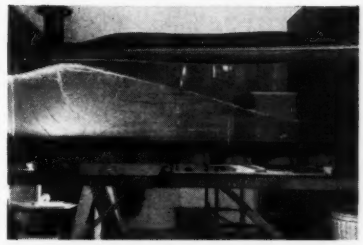


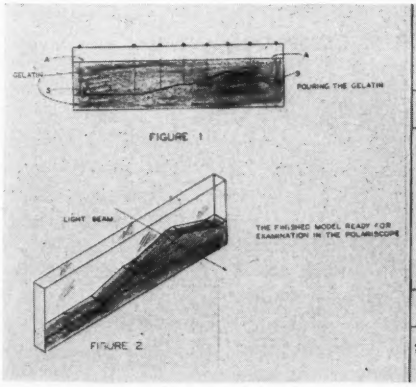
Fig. 3. A close-up of a gelatin model. The dark lines are pencil lines drawn on the glass over the isochromatic fringe pattern.

a shift in fringe value of 10% upon standing 15 hours in atmosphere of about 50% humidity. Further work on this time effect is needed. It has been my experience that the stress-optical coefficient of successive melts and casts of the same concentration may vary from a few per cent to 15% depending upon the treatment of the material.

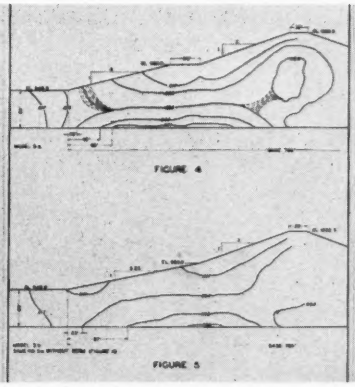
Thus it would seem that detailed study of the elastic-optical properties of one or two samples of present-day gelatin would be of limited value for general application because of the various factors such as change of physical properties with manipulation, remelt, pH value, shrinkage, or swelling of surfaces, etc., as indicated hereto. Nevertheless, such information as is available would indicate that satisfactory models might be made if certain precautions were taken in their preparation, and if the model were examined closely during use for permanent relative retardation, swelling of edges, non-linearity of stress-optical coefficient, etc.

The great optical sensitivity of gelatin makes it possible to set up models for the determination of the shearing stresses produced by the

4. J. Am. Chem. Soc. XLIII, 539 (1921) Trans. Inct. Rubber. Ind. IX, 94 (1933)



Schematic diagram of flume and "template" "S'



Isochromatic fringe patterns of two slope treatments of a proposed gravity earth dam.

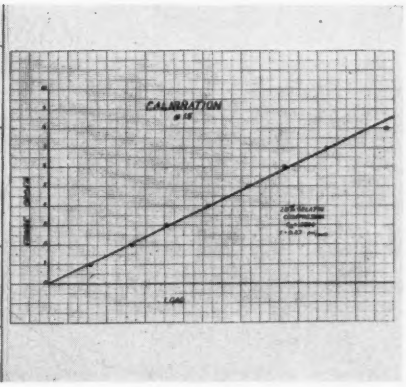


Fig. 6. Typical calibration curve. The fringe value for this specimen, 0.23 p.s.i is the largest I was able to obtain.

weight of the model material itself (commonly called body or gravity forces). Such models were initiated by the U.S.E.D. office at Zanesville, Ohio, and since have been used elsewhere.[5] A typical example of the type of problem for which gelatin forms a practical model material is that of a gravity earth dam, in which the foundation course and the structure itself are of the same type of material. In such cases it is of interest to compare the stresses in the foundation, produced by the mass of the whole structure, for various types of slope treatments. The technique of making the model and experiences in its use will now be described.

Figures 1, 2, and 3, show the flume, 5′ x 16″ x 4″ with 5/16″ plate glass side walls, which forms the mould for the gelatin model. A template or guide, S, made of thin (24 gr.) sheet iron, formed to simulate the surface of the structure to be studied, is suspended in the flume from rods and springs. See Figure 1. Gelatin 8 to 12% by weight is then poured through holes in the template to a depth greater than its top. Since the surface of the gelatin is level with the bottom of the flume, the stresses are hydrostatic and no isochromatic pattern is developed. A difficult problem is to free the gelatin, after setting, from the glass walls. We have found the best method for high models is to stretch, before pouring, a sheet of .001″ cellophane inside the glass. After setting, the model is tipped on its side to about 75° from the vertical and the glass plate removed, whereupon the cellophane may be peeled off carefully. A sharp thin knife is passed along the surface, S, using the template both as a guide and as a stiffener to prevent the gelatin from deforming before the knife. The cellophane is not used with depths less than 6″ as here the gelatin may be cut away from the glass with a thin "chisel-like" knife made from a hacksaw blade. The gelatin-glass interface is lubricated and the glass replaced. The same treatment is then carried out on the other side of the flume.

As the model is returned to its vertical position, the body forces due to the shape of structure come into play, causing deformation of the gelatin with the consequent slippage along the glass wall. The isochromatic pattern so produced, traced on the glass with a grease pencil, is seen in Figure 3. These patterns, for the two different types of slopes, are shown in Figures 4 and 5. That the patterns

Figures 7, 8 and 9

are unsymmetrical under the crest, due to the end wall of the flume nearby, is unimportant since it was at the toe that it was important to compare the stresses. These models were repeated, employing batches of gelatin of different consistency, and somewhat different dimensions. Each time a pattern of equal distribution was obtained, including the little cusp just under the berm. However, a large deformation occurs at the crest; the effect of this deformation needs further study.

Other types of models have been made where the gelatin is simply a rectangular layer to simulate a clay region, and is loaded with some material such as lead shot, sand, etc., in the shape of triangular dams, trapezoidal fills, etc. The material used to produce the loading should simulate as nearly as possible the boundary shearing forces present in the model. Here the deterioration with time discussed herein is very important and its development to a value of appreciable magnitude must be watched for carefully. The gelatin needs to be unloaded after each test and examined for permanent deformation and relative retardation at zero applied load.

The calibration of the material is effected by cutting a right prism 4″ x 4″ x 6″, or of other convenient height and width, from the body of the model and loading the top surface of the prism while in place between the glass side walls of the flume. One individual watches the monochromatic fringe sequence while a second individual controls the loading and records its values. A typical calibration curve is shown in Figure 6. We have found that observations of several individuals agree within 2%. Although this calibration method seems very satisfactory, it is desirable to find some method of cutting the gelatin to a more precise shape.

It is suggested that gelatin forms a model material for purely demonstrative examples which is reasonably cheap, is easy to form in various shapes, and is easily loaded. The material may be cut away to show the effect of a change in shape. High grade, unflavored, food gelatin may be obtained from any wholesale grocer. A fresh model will show no initial bi-refringence. For such examples a small flume 18″ x 2½″ x 7″ is used. This holds about 3 quarts of gelatin melt costing about 30 cents. If proper precautions are taken the material may be remelted and recast 4 or 5 times before it becomes dark or hydrolizes.

The material was cut into various shapes, three of which are illustrated in the figures above. One section was subjected to a concen-

(*Continued on page* 22)

5. (a) Hough, B. K. Jr., Trans. A.S.C.E., 103, 1414 (1938)
(b) Farguharson and Hennes, Civil Eng. X, 211 (1940)
(c) Phillippe and Frocht, Proc. Eastern Photoelasticity Conference, May 1940 (unpublished)

The Story of Paraffin Wax

Production of Paraffin Wax from Paraffin-Base Crude Oil as Observed at the Bayonne Refinery of the Standard Oil Company of New Jersey.

By HENRY E. OTTO, JR., A.E.M.E. '42

PERHAPS you little realized as you sat down to breakfast this morning that the match which lighted the stove, the cap on the milk bottle, the wrapper on the bread—all required the use of paraffin wax. So numerous are the applications for this product, both in industry and in the home, that many plants have been erected to recover paraffin from petroleum.

Seven major operations are required to transform the crystalline wax present in paraffin-base crude oil into the colorless, odorless, and tasteless product in its final form.

Fractionization is performed in a pipe still, which divides the raw crude into cuts. The crude is vaporized in one rapid heating by pumping it under pressure through specially constructed metal tubes set in a furnace. After passing through the furnace, the vaporized oil is introduced into the fractionating tower. The various fractions are separated by progressive cooling —the highest boiling fractions condense on the tower bottom, the next highest on a slightly higher level and so on up the tower. The lowest boiling fractions pass overhead in the vapor state and are liquified in condensing equipment.

Paraffin distillate is the cut from which the refined wax is obtained; it generally contains from ten to twenty per cent wax solution. The method used in the Bayonne refinery to crystallize the wax is to subject the oil to low temperatures created by large ammonia compression units. This refrigeration action takes place in what are called "chillers" — essentially, two concentric pipes through the larger of which passes liquid ammonia, while the oil is pumped through the smaller pipe in the opposite direction. As the ammonia is circulated through the pipe, it is transformed from a liquid to a vapor; the heat necessary to accomplish this change comes from the oil, and in this way the temperature of the oil is reduced. The wax is precipitated from the oil onto the inner surface of the oil pipe. This, it can be seen, reduces the rate of absorption of heat from the oil, and it is therefore necessary to employ a gear-driven scraper, which slowly rotates inside the oil pipe, removing the congealed wax from the walls and permitting it to move on through the system.

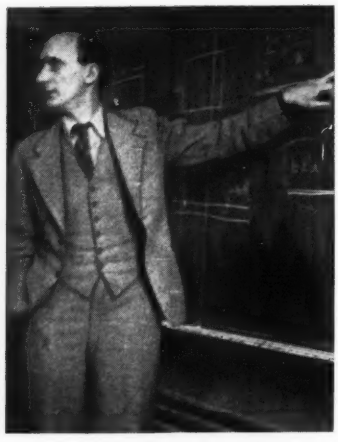
The next step is to separate this congealed wax from the oil. The oil is pumped under pressure into a large press which contains about five hundred canvas-covered discs to which the wax adheres and through which the chilled oil seeps. It is simply a straining operation; as the oil is forced under pressure through a hole in the canvas sheets, the congealed wax is held back, while the oil passes through. The refinery has forty-two of these presses, all of which are in various stages of the pressing process. (The complete process requires about fourteen hours.) It is apparent that the pressure under which the oil is admitted must be increased as the pressed wax coating on the canvas thickens. When it is no longer practical to try to force the chilled oil through the press, the oil is shut off and the five hundred discs of pressed wax are broken up by men with implements known in the refining industry as "spuds". These "spuds" closely resemble the rammers used in our foundry course. The wax cakes fall onto a screw conveyor that breaks and carries the wax to a heated storage pan, where it is melted by steam coils. This wax, known as "slack wax", contains forty to fifty per cent oil.

From the heated storage pans the melted wax is pumped to cone-bottomed agitators where it is

(*Continued on page* 22)

View of the Bayway Refinery of the Standard Oil Company at Linden, New Jersey. The six tall cylindrical tanks are fractionating towers.

AMONG YOU



Prof. J. N. Goodier

Stepping into Professor Goodier's office in West Sibley, we noticed that he has just completed a small model explaining one of the probable causes of the recent failure of the suspension bridge in Tacoma, Washington. He placed the model in front of a fan and the expected periodic motion began almost immediately.

Professor Goodier graduated from Cambridge University, having been awarded a scholarship during each of his three years there. He continued his work there in a post graduate course for two years. Then he was awarded a fellowship offered by the Commonwealth Fund and left his native Preston, England in 1924 to attend the University of Michigan for two years. From that point he stepped into Canada where he worked for the Ontario Research Foundation in Toronto. That institution, he explained, is a localized bureau of standards, a research laboratory for work in industrial chemistry, and handles advanced problems in mathematics, stress vibration and elasticity problems. Professor Goodier spent considerable time in the machine shop, building and designing new machinery to test strengths of materials.

While in Toronto, he prepared a number of papers and lectured rather frequently on the theory of elasticity, which he has developed considerably.

He came to Cornell in 1938 to enter the Department of Mechanics which he now heads, a rapid but deserved advancement.

When asked how he liked engineering schools in the United States in comparison to those in England, he found it rather hard to pair them up at present since a slightly different type of engineering school was prevalent in England when he was there. It seems that Cambridge trains its engineering students in the basic sciences and theory almost entirely. Since Professor Goodier's departure from England, however, a number of engineering schools of the more specialized and practical type, such as we know them, have started in England.

In reply to a question asking which he preferred, England, Canada, or the United States, he said he likes it here very much.

Alva E. Kelley '41, A.E.M.E.

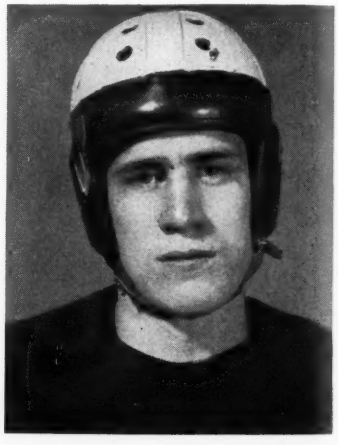
If you've seen the Big Red football team in action this season, you've seen Al Kelley for he handles one of the strategic end assignments on the team. His capabilities are by no means limited to the gridiron, however, for he plays on the varsity baseball team and participates in interfraternity basketball as well.

Al belongs to the football club, Tau Beta Pi, Kappa Tau Chi, Sphinx Head, Aleph Samach, Scabbard and Blade, and Phi Kappa Psi. He runs the film distribution for football motion pictures of the Big Red team and is one of the ace salesmen of a local ice cream company. Besides these, he keeps up his engineering work enough to satisfy qualifications for McMullen and Undergraduate Scholarships.

During the last few summers, he has been working in the maintenance department of the Duquesne Light Company in Pittsburgh. Last summer, he spent six weeks in the Ordnance ROTC camp in Aberdeen, Maryland where he was given the Colonel Gunther award for the most outstanding camper.

Before he came to Cornell, Al graduated from Har-Brack High School in Tarentum, Pennsylvania and then spent an extra year at Shady Side Academy. He played football, basketball, and baseball at both schools.

As far as hobbies are concerned, Al has dropped most of them since coming to college, but retains his art of playing the fife, on which he likes to collaborate with some of the other players during athletic trips. He played the saxaphone



in an orchestra in Tarentum and still strikes up a tune occasionally. He used to keep detailed statistics of baseball players in the major leagues but dropped that when he started his engineering education.

After graduation, Al hopes to work in some position relative to sales engineering or industrial engineering.

It might be added that the interview for this article was supplemented considerably by information from Mrs. Kelley.

ENGINEERS

George A. Gentes '41, Ch.E.

Think of chemical engineering and then of George Gentes—the two seem to be synonomous. You see the reason for this is that he has wanted to be a chemical engineer for just about as long as he can remember. He works hard at it even during the summers, but he enjoys this work because he is really interested in it.

Even with this time consuming course, George has participated in many extra-curricular activities among which are: A.I.Ch.E. (president), Retort and Beaker (past president), Al-Djebar, Scalp and Blade, Student Engineering Council. He was also in charge of the chemical engineering exhibit in

Baker Laboratory on Cornell Day last year.

An independent from Buffalo, George has managed to keep an excellent average in his studies. As a matter of fact, he was awarded a McMullen Scholarship, Scalp and Blade Scholarship, Cornell Tuition Scholarship, and a State Cash Scholarship. He already holds the degree of Bachelor of Science and will get his Chemical Engineering degree this June.

During the last four summers, George has been working along chemical engineering lines. For three summers, he worked with DuPont in their rayon and cellophane divisions. Then, last summer, he worked for the Atlantic Refining Company in Philadelphia in the development department.

George likes administrative courses at Cornell and has arranged his schedule to take as many of these courses as possible. He believes that an administrative knowledge along with a technical one is very advantageous.

Although somewhat uncertain about just what he wants to do after graduation, George prefers some kind of work in connection with plant process improvement.

Edward P. White '41, C.E.

The difference between Ted White and the rest of our engineers is that he pointed for the top and got there, not because of his scholastic ability, for engineering does not come easily to Ted, but because of his perseverance, drive, and likeable personality. He is proud of his position as manager of the Big Red Football Team.

Ted had no personal interest in football, and never even considered going out for the managership competition until it was suggested to him by his fraternity brothers of Beta Theta Pi. But from the moment he started in the spring of his freshman year he concentrated on winning. It was "work like a Turk 'till your eyes ache like hell" for Ted. He was more of a ghost than anything else that first year, arriving late and leaving early for everything except his daily Schoellkopf session which lasted from four in the afternoon until seven or eight at night. Going out to win the toughest competition on the Hill and studying engineering is a job which few men are willing to tackle. With the announcement of his victory serious-minded Ted broke all bounds in a grand celebration.

As team manager, Ted is never very optimistic about the scores of coming games, although he is more optimistic about them than he was of his own safety the time he left the meat off the menu for a road trip meal, and thirty-five hungry players made it rather uncomfortable for him.

Ted's efficiency system has carried him through with flying colors for he has not only been a successful football manager, but has been elected to Pyramid and Kappa Tau Chi as well as Aleph Samach and Sphinx Head.

When not engaged in managerial activities Ted is usually found at the Beta House where he takes a very active interest in his fraternity. Listening to records of his symphony collection and attending Bailey Hall Concerts is another side of his education.

Ted spends his summers on the family farm where he has grown to love outdoor activity. Consequently it is painful for him to watch his roommate, Hal Robertson, tramp off to the woods for an afternoon of hunting when he has some slide rule exercises to do. Last summer he forsook the fifty acres near Utica in favor of a job in a magnesium foundry where he learned the meaning of the word "empirical."

After three and a half years of engineering Ted is convinced that he is no research engineer, and plans to enter sales work after graduation.

CORNELL SOCIETY of ENGINEERS

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22 East 40th St., New York, N. Y.

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HENRY B. BREWSTER '98, Vice President
615 James St., Syracuse, N. Y.

PAUL O. REYNEAU '13, Secretary-Treasurer
Cornell Club, 107 E. 48th St., New York, N. Y.

HERBERT B. REYNOLDS '11, Recording Secretary
600 W. 59th St., New York, N. Y.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

Fellow Engineers:

It seems fitting to report to the membership at this time that the Cornell Society of Engineers has more members than last year at this time—another year of solid growth. Your Society is not a new organization, and although it is not as old as engineering at Cornell, it has a venerable, successful record of growth and accomplishment. Unlike many organizations which have reached the age of maturity, however, the Cornell Society of Engineers has not stopped growing. It is my feeling that during the past ten years an unusually successful program of change has been carried out in such fashion that the organization of the Society has been adapted to the new conditions and has been put in a stronger position to carry on its objectives.

Probably the most significant of these changes was the plan which enables the Society to function truly as a national body rather than solely as a New York unit. The sphere of active influence of the Society has been spread to match more nearly the sphere of influence of all Cornell engineering alumni under the change in constitution which now permits and encourages the establishment of live branch or regional groups.

As one of the first steps to bring about a more national interest and feeling arrangements were made thru the cooperation of the CORNELL ENGINEER to provide an opportunity for frequent messages to all of our members.

During the past four years, first John Lawrence, and now Professor John Bangs, respective chairmen of the Committee on Regional Sections have devoted much personal time to the building of a solid background for the development of active regional units of the Society.

Groups of Cornell engineers, members of the Society, have established their own regional sections, under the guidance of this committee, at Pittsburgh, Philadelphia, and Syracuse. This is just a beginning. Other sections are in the process of organization.

There are large numbers of Cornell engineers in many other locations large enough to form units of this Society, and through the organization of those units, to develop a more active membership that will be in a better position to be useful in the advancement of engineering at Cornell.

I am devoting this letter entirely to the subject of regional sections because I share the feeling of many of our past and present officers as well as members of the faculty at Ithaca that the usefulness of the Society can be expanded in direct proportion to the increase in live regional activities. Those of you who are now members of the Cornell Society of Engineers in Chicago, Cleveland, Detroit, Buffalo, Rochester, Boston—to mention just a few important Cornell cities—to you membership in the Society can mean much more if you partipate in an active regional group.

It is not difficult to point out to you exactly what steps may be taken to develop a group of interesting Cornell engineering meetings and discussion groups which will well repay the small amount of effort necessary. From these informal beginnings you can create a renewed local interest in Cornell engineering at Ithaca that may prove a real contribution to the College. Many local alumni have lost touch with the schools of engineering and their activities. The Society offers an excellent medium to rekindle this interest and to fan it into direct action of benefit to Ithaca. Someone has to be the spark plug. I hope that it will be you—the reader of this letter. Write to Professor John Bangs in Ithaca at once and tell him that you are interested in bringing together a group of Cornell engineers in your area that are interested in keeping in touch with the College of Engineering at Ithaca and other Cornell engineers. He will be glad to help you get organized and will put you in touch with others from the same area with the same idea.

For the information of those who wish to develop a regional section, the Society has made definite provisions for assistance, some of which are as follows:

(a) Each regional section may define its own territory.

(b) Headquarters of the Society will be glad to see that you are provided with lists of all the Cornell engineers in your area together with their addresses to assist you in mailings and announcements of meetings.

(c) The region may appoint its own chairman and such organization or committees as it feels desirable. The designated chairman will become a Regional Vice President and member of

(*Continued on page* 21)

Some 21,500 cars and trucks are in regular day to day service with the Bell System. The great majority have bodies specially developed by telephone engineers. Many are equipped with power winches, air compressors and pole derricks. Each of the many types is designed to handle particular functions in the construction and maintenance of telephone plant.

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News of Our Alumni

In 1911 Norman T. Tilley entered Cornell University to learn something about engineering. He wanted to become a steam engine expert. As a student who had to help support himself in college, Mr. Tilley found relatively little time for outside activities, but he did manage to run on the cross country team his first, second, and fourth years. He also joined the Acacia Fraternity. After completing his junior year at the university, Mr. Tilley stayed out of college for a year for two reasons: first; to learn something about engineering, and second; to earn some money. He did both these things by working for The Pierce-Arrow company. Finally, in 1916, he received his M.E. degree.

A year of work and three years of college education changed the mind of the man who wanted to become a steam engine expert—now he found his real interest in internal combustion engines, a change for which the engineering profession can be thankful. Finding four years of formal education not enough, he stayed at Cornell to get a Master's degree. But those were days of war, and there was need of qualified instruction in airplane technology, so Grad Student Tilley became an instructor down at the Ithaca Airport, at that time an Army training base. In the process of explaining the airplane motors to the pilots, he had to assemble and break down several types of airplane motors a good many times. It is to this experience that Mr. Tilley now attributes much of his practical knowledge of airplane engines.

From this point on Norman Tilley remained an airplane engine man. At the Ithaca Airport he also learned how to fly, and with a rather extensive knowledge of the airplane at his control, he entered the Army Air Corps. As an Army pilot, he was first a flying cadet at Kelly Field and later an airplane pilot and engineer officer in charge of various training courses. He left Kelly Field in 1920 to teach mechanical engineering at New Mexico A. and M. College and at the University of Texas. While in Texas, he became a married man.

Following two years as an instructor, Engineer Tilley went back into the Army Air Service, this time at the experimental station in Dayton, Ohio. But now private industry demanded the services of this man, and the history of the airplane engine expert becomes something of a roll-call of American airplane manufacturers. Fortunately, Mr. Tilley enjoys travelling—his career has involved a great deal of it. Included among his affiliations were: Kinner Airplane and Motor Corporation at Glendale, California; American Airplane and Engine Corporation, Long Island; Continental Motors in Detroit; Lycoming Division of the Aviation Corporation of America in Pennsylvania; and finally, The Lawrence Engineering and Research Corporation at Linden, New Jersey. During his employment with Continental Motors, Mr. Tilley developed a 50 H.P. airplane engine which weighed as much as the 40 H.P. engine of the time. This meant that small planes could have radio accessories and other accessories without significant disadvantages. In his repertoire of engineering experience, he has been consultant on airplane engines for the Chrysler Corporation in Detroit and he also is Vice-President of the Society of Automotive Engineers in charge of aircraft-engine activity.

When engineering activities are not calling, Mr. Tilley enjoys a game of golf or a trip. These are his main forms of relaxation, but he also would like to have a sailboat. Unfortunately, he isn't in one spot long enough to get a boat in the water. Mr. Tilley has two children, Nevil and Jane, both good Cornell prospects. His nephew, William H. Tilley represents his name well at Cornell, Bill being top man of the third year Chemical Engineers.

Alfred D. Blake, a graduate of Sibley School of Mechanical Engineering of the year 1907, has made good use of his undergraduate training in journalism as Editor of the *Sibley Journal*. Upon graduating, Mr. Blake entered the employ of Westinghouse, Church, Kerr, and Co., where he worked for several years in power plant construction work. Following this experience, Mr. Blake joined the McGraw-Hill Publishing Company and was Managing Editor of *Power* until 1932, except for two years during the World War when he served as a Major in the Engineering Division of the Ordnance Department. Since 1933 he has been with Combustion Engineering Company, builders of large boilers and fuel burning equipment, in the capacity of Editor of *Combustion* and also in charge of technical publicity for that company.

Mr. Blake is also a regular contributor to the New International Year Book, a joint author of the Power Plant Section of the Chemical Engineers' Handbook, and author of the chapter on Boilers in the new edition of Mark's Mechanical Engineers' Handbook. His outside interests include the A.S.M.E. where he has served on numerous committees, particularly during the last World Power Conference as Chairman of the Round Table Conference Committee.

"Meet Mr. Collyer!" Thus *Barron's*, the national financial weekly, salutes John L. Collyer, '17 M.E., now president of B. F. Goodrich

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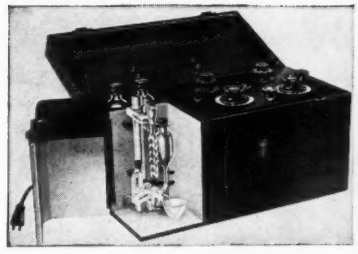

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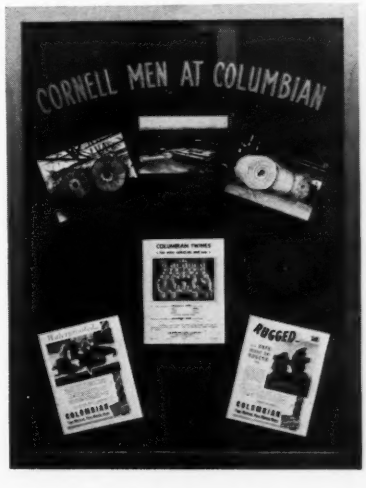
Co. Quoting Damon Runyon's account of a long-past Poughkeepsie regatta in which Cornell overcame a big California lead, the article begins: "The bow of the Cornell boat crept up with Collyer stroking the crew in masterly fashion. There was none of that wild, berserk dash of the Californians to this drive, but a cool calculated reach for victory, and it won." Continuing, "This sentence, in a sense, epitomizes the business career of John L. Collyer. For it is this ability to plan and organize calmly and scientifically, and then to drive hard along the line decided upon, coupled with a capacity for taking pains, that has advanced Collyer from a $6-a-week ship worker to the presidency of one of our greatest rubber manufacturing companies—B. F. Goodrich Co." The article describes Collyer's personality and career in detail, ending with his interest in developing synthetic rubber. His previous work with Dunlop Co. made him conscious of the difficulties which the U.S. might encounter, were the Eastern source of rubber supply cut off. Experiments at Goodrich have led to the manufacture of passenger car tires made of Ameripol, which have sold sufficiently to strengthen Collyer's belief that, with the support of the Government and the public, the production of rubber substitutes can be gradually increased to a level materially alleviating the danger of a serious rubber shortage.

Wiser Brown, '17 M.E., first vice-president and general manager of American Magnesium Corporation denied in a recent interview with the New York Herald-Tribune, assertions of the Department of Justice that there is German control of magnesium manufacture in this country. American Magnesium, which is partly owned by the Aluminum Co. of America holds general patents, a number of which were formerly owned by a German company, he said. Re-

(*Continued on page* 20)

Columbian Rope Co.

G. R. Beebe '25 B.Chem., M.Chem.
K. H. Bowen '24 M.E.
H. D. Daboll '35 B.S. in A.E.
E. B. Johnson '15 '24 B.Chem. PhD.
R. L. Morris '17 M.E.
F. D. Ramsey '24 M.E.
N. R. Randall '30 M.E.
R. T. Starr '21 M.E.
A. K. Strong '21 B.S.



News of the Engineering College

From Sibley comes news of a heat experiment, which should be of considerable interest, not only to engineers, but to the uninitiated as well.

Credit for the design, adoption, and execution of the experiment goes to Professor Sawdon and Dr. Dropkin of the M.E. School.

In Professor Sawdon's own words, the purpose is, "to investigate the fundamental properties of radiation with a view to improving radiator testing processes."

We all recognize the steam radiator as an important unit in many heating systems, but few of us stop to realize that such radiators can be sold only after certain rating standards have been met.

The code of the American Society of Heating and Ventilating Engineers, specifies that these tests must be made with the radiator in a room whose constant temperature is 70°F. at a distance of five feet from the floor.

In practically all existent testing laboratories, observations are conducted in a room whose temperature is controlled from without by coils filled with a refrigerant of some sort. However, this method holds many disadvantages, for the coils themselves absorb radiant heat, and thus it is impossible to maintain a constant temperature in all parts of the room.

Professor Sawdon and Dr. Dropkin believe that they have largely eliminated this disadvantage by indirectly cooling their testing room. This is managed by bringing ordinary air in contact with cooling coils filled with ammonia. The air is then conducted to the testing room by means of a large duct. After circulating around the outside of the testing booth, it is removed through an opening at the floor level, and is cooled all over again. The temperature of the ammonia in the condensing coils is controlled automatically by electrically operated compressors.

The actual experiment is being performed in the "cold room", a highly insulated, refrigerator-like construction in the West Mech. Lab. Within this room, another room is built, around which air is free to circulate. Within this inner room the radiator is placed.

The room containing the radiator is sided with masonite. From its ceiling to its floor are suspended a number of thermocouples at various levels. The thermocouples are connected to a recording potentiometer, from which data are gathered.

The first test of the radiator was made without insulating the inner room at all.

The second observation was taken after the ceiling had been insulated with glass wool. It was found that this change affected the temperature distribution in the room.

Next, two walls, and the floor were insulated to simulate a corner room of a house.

In the final observation, the entire room will be insulated with the exception of one wall.

The most difficult part of the entire experiment is to obtain a temperature equilibrium in the inner room. To do this, the "cold room" temperature must first reach a state such that the temperature in the testing booth is 70°F. This temperature must then be maintained throughout the observations.

This process is a tedious one, which always requires several hours. As the observer must remain in the "cold room" during the operation, so as not to upset the equilibrium, and as the atmosphere is usually a bit chilly, the duty is not a particularly pleasant one.

The apparatus for the experiment was constructed during the last summer. The University, realizing the importance of such observations, went to considerable expense in setting up the equipment. This has resulted in what is probably one of the best testing establishments of this type throughout the country.

The dream of many a college student—a radio station built and operated by students—is now a reality. Differing from commercial radio stations only in size, station CRG, brain child of the five-year old Cornell Radio Guild, offers excellent training in every branch of radio. The entire personnel of CRG is composed of students. The powers behind this new campus voice are J. Robert Meachem, '41, President, and G. Emerson Cole, '41, Station and Program Director. Meachem, an electrical engineering student, with two years of experience as President of the Cornell Radio Guild behind him, has worked out the technical arrangement. Cole, a student in Administrative Engineering, also has had two years of Guild experience and was a professional announcer for WHCU.

Selecting Willard Straight Hall as its studio, CRG has installed small oscillator units in the dormi-

Chi Epsilon

CLASS OF 1942

Mateo Lian Poa Go
John Melchior Hansen
Paul W. Leighton
John Frederick Mattern
David Warren Milhan

GRADUATE STUDENTS

John Dmitri Jarema

Atmos

CLASS OF 1941

Frederick Demmler Amsler
Charles Edward Boak
David Morris Bradt
Richard Mott Durbin
Robert Powers Northrup

CLASS OF 1942

Samuel Randall Converse, Jr.
William Chalmers Fleming
Richard Alton Graham
Lloyd Jackson Moulton
Ferdinand Philip Schoedinger

Pyramid

CLASS OF 1942

Joseph Louis Boyer
Alfred Morris Entenman
John Melchior Hansen
Edmund Gaudette Miller
Baird Anthony Mitchell
Stephen Allen Smith
James Gregory Tripp

tories. Telephone lines carry programs to the oscillators where the program can be tuned in on an ordinary radio. Oscillators are also to be installed in fraternities and rooming houses for which a rental charge and installation fee are to be paid.

Operating four hours a day, CRG offers programs of special interest to students. Besides offering a complete coverage of all sports, CRG will broadcast all musical concerts, forums in the Willard Straight Memorial Room, and the Sunday afternoon reading hours in the Browsing Library. The entire collection of records in Willard Straight and the Music Department has been placed at the disposal of the Guild. Publicity is available for any campus group but advertising is kept down to a minimum.

Engineering students can gain practical experience if they are at all interested in radio. Students are building and servicing oscillators. Professional training in the mechanics, production and business side of a radio station is under the guidance of the faculty and personnel of station WHCU.

One of the first student-operated radio stations on a college campus, CRG has joined the Intercollegiate Broadcasting System. Membership in this system allows our campus station to exchange football broadcasts and intercollegiate debates.

Radio seems to have dominated campus events lately. At a lecture sponsored by the School of Electrical Engineering on October 23, Mr. Lee McCanne of the Stromberg Carlson Manufacturing Company, spoke on frequency modulation. This new system of broadcasting is now being used on very high frequencies to eliminate natural and man-made static and to cut down the interference between stations. Bringing a frequency modulated transmitter and receiver with him, Mr. McCanne demonstrated this new system of broadcasting which utilizes frequency modulation instead of the regular method of amplitude modulation. On October 25th, Walter Jones of the Sylvania Tube Company spoke before a joint meeting of the student and Ithaca branches of the A. I. E. E. on "Why Tube Engineers Turn Grey." Mr. Jones supplemented his lecture with a demonstration of fluorescent lighting, using a board that employs ultra-violet radiation to show electron tube performance.

Everyone has been closely following the record of the Cornell Football team. Of interest to engineering students is the fact that many of the players on the team (15 to be exact) are engineers. The stellar work of end Al Kelley, '41, will never be forgotten. Elsewhere in this issue appears an article about Al. Pete Wolff, A.E. '42, not only scorerd a touchdown after a blocked kick in the Army game but also was superb on the defense against Columbia. To completely describe the part engineers played in Cornell's winning football combination would take an entire article. Sometimes we forget the part the manager plays in making a great football team. Certainly the work of Ted White, C.E. '41, as manager had a great deal to do with Cornell's having a successful football team. Most of us know the names of the men on the football team, but engineers would probably like to know who are engineers. The following men on the Cornell varsity football team are students in engineering: Norman L. Christensen, A.E. '42; Donald R. Goodkind, C.E. '42; Louis G. Helmick, M.E. '43; Dver B. Holmes, E.E. '43; Roy V. Johnson, A.E. '42; Alva E. Kelley, M.E. '41; Daniel C. Nehrer, M.E. '43; Richard F. Rochow, A.E. '43; Richard L. Stimson, M.E. '41; Kenneth L. Stofer, A.E. '43; Joel R. Swanson, A.E. '43; Harry L. Tredennick, E.E. '42; Edmund Van Order, C.E. '42; William H. Webster, A.E. '42; Peter M. Wolff, A.E. '42.

New Captain

Peter M. Wolff A.E.M.E. '42 of Highland Park, Ill., was elected captain of next year's Big Red Team following Cornell's closing game with Pennsylvania.

Pete is one of the outstanding men of the Junior Class both on the gridiron and in other activities.

We wish him all success in leading Cornell's grid warriors next year.

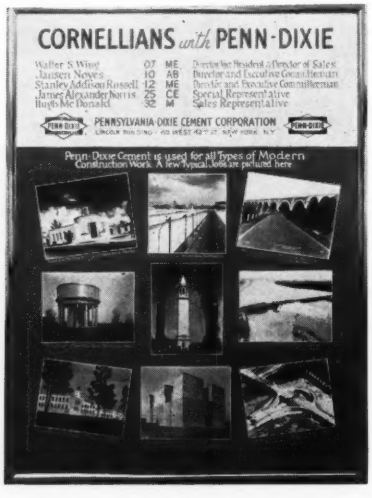
Engineering societies on the campus are busy organizing and planning their programs. In the E.E. school, the A.I.E.E. has sponsored the lecture by Walter Jones on radio tubes and on November 9 a man from the Weston Company described electrical instruments. A meeting, probably a smoker of the A.I.E.E. is planned for November 29. All of these meetings are held in Franklin Lecture Room. Eta Kappa Nu, honorary society in E.E., held a smoker November 6. Dr. Lewis, director of the School of Electrical Engineering, spoke on Cornell's participation in the national defense program, and Bob Meacham described the new radio station CRG. One of the freshman electrical engineers mystified those present with a batch of magic tricks. On December 6 Kappa Tau Chi, honorary society in Administrative Engineering, is holding an open meeting. Freshman and sophomores in A.E. are especially invited to attend. Professor Magoun, who gave a lecture in Willard Straight a short time ago, will be the speaker. The meeting is to be held at the Alpha Delta Phi fraternity house.

Over in the Civil Engineering School, activities are rushing ahead at full speed. At a meeting of the A.S.C.E. on November 7 a film, "The New Story of Ancient Wrought Iron" was shown. Coach Scotty Little showed films on deep sea fishing, and Cornell swimmers in action at the A.S.C.E. Smoker October 15. The Pyramid Society is planning for elections and an initiation in December. Jack Segal, C.E. '43, received the Chi Epsilon award for the highest cumulative average during his freshman year in Civil Engineering. This honor society in C.E. is also planning for the initiation of its new members in December. Chi Epsilon is already beginning to work on the Cornell Day Engineering Show and is making a plaque with the names of its members to put in Lincoln Hall for the benefit of future generations.

An enthusiastic crowd of 245 men turned out for the Chemical Engineers' banquet on November 8 in the Martha Van Rensselaer Auditorium. Professor "B. A." Adams gave a running commentary on travel and foods (too bad some of the Home Ec students weren't there), and Dean Hollister described the place of the engineer in the national defense program. "Dusty" Rhodes, Director of the School of Chemical Engineering explained the place of the Chemical Engineer in society. After the formal talks everyone joined in group singing.

The A.S.M.E. is carrying on a membership drive and they have already passed the century mark. Among the lectures sponsored by this group in November was one on Timken Roller Bearings. Mr. Snelling, a Washington lawyer, also talked to a joint meeting of the local and student branches of the A.S.M.E. One of the big events on the schedule is the annual convention in New York City, December 6, and Cornell is sending at least one delegate.

Among the lectures given in Sibley were two on employment and one on national defense. The employment talks were given by Howard L. Davis, vocational director of Brooklyn Polytechnic Institute, and P. W. Boynton, a former Ithacan who is supervisor of employment for the Socony Vacuum Company. C. S. Coler, '11, who is now with the Industrial Relations Department of the Westinghouse Company, gave the talk on "National Defense."


CORNELLIANS with PENN-DIXIE
Walter S Wing 07 ME
Jansen Noyes 10 AB
Stanley Addison Russell 12 ME
James Alexander Norris 25 CE
Hugh Mc Donald 32 M
PENNSYLVANIA-DIXIE CEMENT CORPORATION
Penn-Dixie Cement is used for all Types of Modern Construction Work. A few typical jobs are pictured here

Pennsylvania Railroad

Donald W. Adams '29 M.E.
John A. Baum '05 C.E.
James S. Bell '23 M.E.
Foster S. Bowden '27 C.E.
Edwin H. Brown '22 E.E.
John S. Fair, Jr. '28 M.E.
Rufus H. Flinn '09 M.E.
Allan O. Geertz '22 M.E.
Grandin A. Godley '37 M. C.E.
Thomas M. Goodfellow '29 C.E.
Frederick G. Grimshaw '00 M.E.
Lloyd B. Jones '04 M.E.
Maurice H. Lingenfelter '26 M.E.
Edward F. Mason '05 M.E.
James W. Miller, Jr. '34 B.S.
Clare O. Shull '17 M.E.
Charles Weiss '13 C.E.
David P. Williams '98 L.L.B.
Charles D. Young '02 M.E.
James W. Young '30 M.E.

John McMullen Regional Scholarships have been awarded to five more students now enrolled in the College of Engineering, Dean S. C. Hollister announced recently.

Those receiving the scholarships are Richard Maurice Severino, A.E. in M.E. '42; Robert Charles Wells, M.E. '43; Melvin Lane Garrett, C.E. '44; William Clifford Taylor, C.E. '44; and Joseph Lincoln McGinnis, C.E. '44.

Alumni News

(*Continued from page* 17)

cently American Magnesium opened its fifth plant at Buffalo, where 800 workmen will be employed. Other plants are at Cleveland, Ohio; Garwood, N. J.; New Kensington, Pa.; and Los Angeles, California.

Cornellians With Penn-Dixie

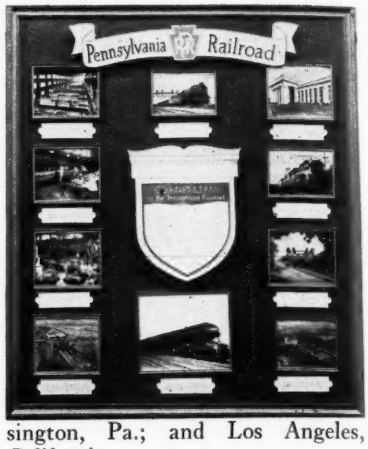
Walter S. Wing '07 M.E.

Jansen Noyes '10 A.B.

Stanley Addison Russell '12 M.E.

James Alexander Norris '25 C.E.

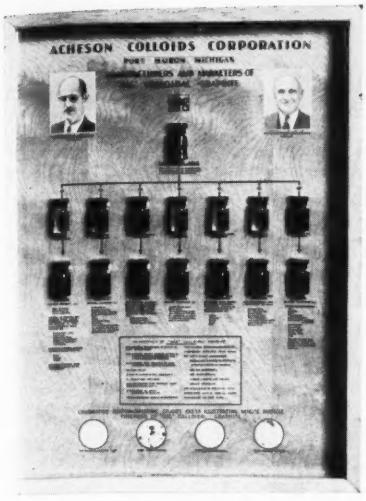
Hugh McDonald '32 M.



W. L. Cisler, a graduate of the College of Engineering, Cornell University in 1922, who is now assistant chief engineer in the electrical department of the Public Service and Gas Company, Newark, N. J. was recently appointed chairman of the American Institute of Electrical Engineers committee on power generation for 1940-41. He has been a member of the committee since 1935.

After graduating from Cornell, Cisler entered the Public Service company as a cadet engineer in the training course and from 1924 to 1926 was test engineer in the Marion and Kearny generating stations. In 1926 he became assistant chief engineer at the Peterson station and in 1927 chief engineer of the Marion station. From 1931 to 1935 he was planning and installation engineer and in 1935 he became general manager of the electrical department. He was promoted to his present position in 1938.

Tell Berna ME. '12 general manager of National Machine-Tool Builders Association, announced the designing of a machine capable of turning out one shell forging a minute, at a recent joint meeting of the American Society of Tool Engineers and the American Society of Mechanical Engineers, in Cincinnati, Ohi. The machine, designed at the request of Army ordnance officers for a single-purpose machine which would be inexpensive, quickly built, and productive in the hands of untrained operators is now under continuous-life test at a South Bend, Ind., plant.



Selection of five junior members of the Student Engineer's Council has been announced by N. T. Nelson '41, chairman. Junior classes of the respective engineering schools have elected R. A. Graham in M.E., W. J. Sloughter in E.E., F. S. Hathaway in Chem.E., and R. MacCallum in C.E. T. W. Wilson has been selected as the junior representative of the CORNELL ENGINEER.

Faculty advisers appointed by Dean S. C. Hollister of the College of Engineering, include Prof. O. J. Swenson, Chem.E.; Prof. J. R. Moynihan, M.E.; Prof. R. F. Chamberlain; E. E.; Prof. H. T. Jenkins, C.E.; and R. F. Howes as representative of the Dean.

Senior members of the Council, who hold over from last year, are Nelson, representing M.E., E. Friedrich in E.E., G. A. Gentes in Chem.E., H. W. Lansing in C.E., and R. C. Ross of the CORNELL ENGINEER.

The Council has general charge of student events in the College of Engineering, including the annual Engineering Show given at the time of Cornell Day each spring.

Seven army officers from Turkey are among the late registrants this fall at Cornell University. The detachment, composed of a captain, three first lieutenants, and three second lieutenants, enrolled several days ago for work in the School of Civil Engineering. Four were admitted to the Graduate School and three to the College of Engineering as undergraduates.

They came here to take special work in photogrammetry and geodetic surveying, on advice of the Turkish ambassador in Washington.

Newsreel pictures of the recent collapse of the Tacoma Bridge were shown at Cornell Monday, November 25, by courtesy of MGM. The moving pictures showed how the great suspension bridge began to

(*Continued on next page*)

Acheson Colloids Corporation

Howard A. Acheson '23 M.E.

Morris W. Reynolds '18 Agr.

Turner Construction

DeForest H. Dixon '96 C.E.
Egbert J. Moore '99 C.E.
Walter K. Shaw '13 C.E.
William E. Ball '13 M.E.
Gibson M. Allen '28 C.E.
Earl R. Andrew '21 C.E.
Rudolph L. Cullum '15 M.E.
Merton A. Darville '12 C.E.
Alfred W. Folsom '36 C.E.
Henry Gally, Jr. '34 C.E.
John B. Harlow, Jr. '36 C.E.
George S. Kube '33 C.E.
Harold Sidenius '38 C.E.
Gordon F. Stofer '37 B.Arch.
James R. Webb '11 C.E.
Harry T. Welty '32 C.E.

President's Message

(*Continued from page* 14)

the national Executive Committee of the Society.

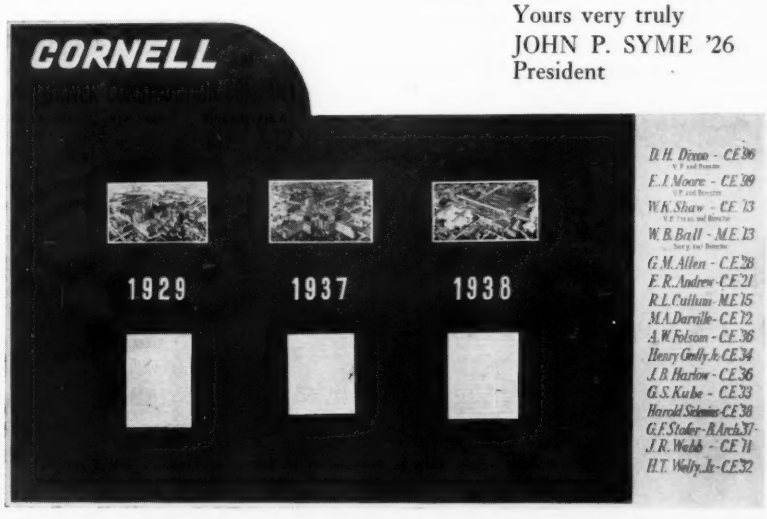
(d) Fifty cents of the $2.00 membership fee of each regional member will be returned to the region for its expenses for the year.

(e) The Officers and Executive Committee of the Society will be delighted to assist in organization, in developing programs and in pointing out means by which the local region may be of real and practical assistance in carrying out the objectives of the Society.

Let's continue our growth! Let's further our opportunity to "promote the welfare of the College of Engineering . . . and to establish a closer relationship between the college and its alumni." Let's get going NOW! Each one who reads this who is not in one of our four established regions should elect himself a Committee-of-One to see that an active regional organization be developed this Winter.

News Item: On Thursday evening, December 5th, the New York Region will hold at "At Home" at the Cornell Club of New York for members of the faculty and alumni who will be in town for the annual meeting of the American Society of Mechanical Engineers. Our guests of honor will be our own Dean Hollister and J. Carlton Ward, President of the Fairchild Engine & Aircraft Corporation, who has recently returned from France.

Yours very truly
JOHN P. SYME '26
President


CORNELL
1929
1937
1938
D. H. Dixon - C.E. '96
E. J. Moore - C.E. '99
W. K. Shaw - C.E. '13
W. B. Ball - M.E. '13
G. M. Allen - C.E. '28
E. R. Andrew - C.E. '21
R. L. Cullum - M.E. '15
M. A. Darville - C.E. '12
A. W. Folsom - C.E. '36
Henry Gally, Jr. C.E. '34
J. B. Harlow - C.E. '36
G. S. Kube - C.E. '33
Harold Sidenius - C.E. '38
G. F. Stofer - B.Arch. '37
J. R. Webb - C.E. '11
H. T. Welty, Jr. - C.E. '32

College News

(*Continued from preceding page*)
sway in the wind and finally broke into pieces to fall into the water below. Accompanying the showing of the film at 4:30 p.m. in the main lecture room of the Baker Laboratory of Chemistry was a lecture by Professor J. N. Goodier of the Sibley School of Mechanical Engineering on "Certain Types of Mechanical Vibration."

Photoelasticity

(*Continued from page* 10)
trated load on the upper surface. The resultant contours of shearing stress are shown in Fig. 7. The concentration of stress at a sharp corner is seen in Fig. 8 where one part of the cantilever beam has been cut to a very small radius of curvature but the other is formed to a much larger radius. Later a small notch was cut in a portion of the beam, and the resultant stress concentration around the notch is seen in Fig. 9. Such models may be submerged in hydrolized gelatin of practically the same density in order to eliminate body forces.

At this point a few items, not mentioned hereto, concerning the handling of gelatin, may be in order.[6] Merck's n-Butyl para-hydroxybenzoate, used at 0.02% concentration, based on dry weight of gelatin, is recommended as preservative. Dowicide is also satisfactory. Keystone No. 99 is the best of the types of gelatin that I have tried. Cold water should be added to the gelatin and the mixture allowed to stand until the swelling appears to be completed. During the melting both time and temperature are factors causing deterioration. Melt the mixture in a double boiler as rapidly as possible at temperatures under 120-130°F. Keep the gelatin in liquid form for as short a time as possible. It is best to store the gelatin mixture at not below 40°F. in order to reduce the time necessary to reach the melting point when remelted.

Probably the most troublesome problem in the model technique itself is the lubrication of the glass-gelatin interface so as to prevent friction on this plane from introducing undesired forces. We have tried water, glycerine-water mixtures, pure mineral oil, and hydrolized gelatin.[7] The water and glycerine both react with the gelatin to produce swelling, in some cases enough to produce ½ fringe order in 4 to 5 hours. Furthermore, they seem to need constant replenishing. The mineral oil is barely satisfactory; it gives a slick, lasting surface, but in time causes swelling having the appearance of blisters on the surface. The material used on the gelatin surface is partly responsible for the swelling and consequent necessity for the discard of the model. Just what factors control this aging of the gelatin is not known. Hydrolized gelatin is by far the most satisfactory liquid for lubricant.

The author wishes to thank Mr. Howard Simpson for making the small flume shown above.

6. I am indebted to the American Agricultural Chemical Co. for certain suggestions of this nature.

7. See 5b.

Paraffin Wax

(*Continued from page* 11)
batch treated to remove any moisture or impurities that may be present. In this operation sulphuric acid is used as a dehydrating agent to extract the moisture from the wax. The wax is then subjected to another sulphuric acid treatment in order to remove impurities which give it an undesirable color and odor. The wax is next neutralized by a caustic soda solution, after which it is washed with water. The acid sludge which is withdrawn from the bottom of the agitators is heated with steam in order to recover any separable acid, and is then mixed with heavy oils and burned as fuel.

The treated slack wax must now be separated into the various grades. This is accomplished by pumping the liquid wax into a series of large pans, known as wax pan sweaters, in which the wax is supported by a screening. In the wax, directly above the screening, is a coil of pipe which passes back and forth across the pan. When the melted wax is pumped into the pans, it is chilled until solid by water running through the pipe coils. The temperature of the solid wax is then slowly raised by passing warm water through the coils; this "sweats" the wax, and the oil trickles through the screening into the pan below, whence it flows away. The color of the wax is improved from a brownish yellow to a pale yellow, most of the color in the slack wax being carried away with the oil during the sweating.

The wax obtained after the first sweating operation is commonly termed paraffin scale and is sold as a semi-refined product for use in leather processing and in making such products as matches, wire insulating compounds, and textiles.

To separate the paraffin wax into the various melting point grades, it must be resweated and by fractional crystallization the different melting point stocks can be produced.

The melted sweated wax is filtered at high temperature (usually around 180°F) through bone char or Fullers earth, rendering the resulting product colorless, odorless and tasteless. The filtration and decolorization of the wax is accomplished in large upright cylinders by means of gravity. The filter medium absorbs the tar and asphalt compounds and is used in the proportion of about one ton of Fullers earth to five tons of wax. The filter medium may be revivified and used over and over again if the coloring matter and residual waxy and oily material are burned out.

The refining of the wax has now been completed and all that remains is to put it into convenient form for the market. From the filters the refined melted paraffin is poured into molds which consist of a battery of water-cooled forms. The paraffin solidifies in these forms and is thereby fabricated into convenient marketing size—20 in. by 12 in. by 1½ in. Refined waxes are used in the manufacture of candles, wax paper, chewing gum, paper cups, artificial flowers, waterproofing compounds, wax polishes, and many other products.

Paraffin wax is evaluated by its color, melting point, specific gravity and lack of oiliness; it is marketed, however, according to melting point which may vary anywhere from 105°F to 140°F.

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PHOENIX HOSE

$1.35 Pair

Her eyes will shine on Christmas morning when she sees your gift of lovely, sheer Phoenix hose. We'll help you select the correct size and shade and guarantee she'll love them!

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DIAL 2711

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Available now with the new Chrome Face Line, the "Wolverine" is a better steel tape than ever. The jet black markings are easy to read against the satin-chrome surface that won't rust, crack, chip, or peel. Line ¼ inch wide. See it at your dealers. Write for Free Catalog 12B.

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so do your shopping while you can

We can help you a lot with

Perfume Sets
Powders
Bath Salts
Mens Shaving Sets
Electric Razors
Travel Kits
Candies
Games — Toys

Stress and Strain

A lunatic was leaning out of an asylum window and watching the gardener.

"What are you doing there?" he asked.

"I'm putting manure on the strawberries."

"I usually put sugar on them, but of course I'm mad."

* * *

Lady shopper: I want some grapes for my sick husband. Do you know if any poison has been sprayed on these?

Grocer: No ma'am, you'll have to get that at the druggist's.

* * *

It was a tense moment, then suddenly the student pilot saw one wing disappear, and his face went white. Immediately the other one disappeared and he grew frantic.

"For Heaven's sake Captain," he yelled, "can't you at least save me a drumstick?"

—Arkansas Engineer

* * *

"Hello, is this the City Bridge Dept.?"

"Yes, what can we do for you?"

"How many points do you get for a little slam?"

* * *

He: "Please!"
She: "No!"
He: "Just this once!"
She: "No!"
He: "Aw, Ma, all the kids are going barefoot."

—California Engineer

* * *

Say, did you hear the one about the . . . Oh, Oh, I'm sorry but . . .

Roses are red, violets are blue,
We know some jokes we can't tell you . . .

* * *

"It's so simple," explained one of the Physics assistants, "to hook up electric power circuits. I merely fasten leads on terminals and pull the switch. If the motor runs, we take our readings. If it smokes, we sneak it back and get another one."

Jones was showing his wife and her friend around the new offices. He left them in the reception room while he answered a telephone call, and the conversation between the two women drifted to household matters.

"Have you put up much fruit this year?" asked the friend.

"Not very much so far," answered Mrs. Jones, as her gaze wandered to several pretty stenographers, "but I intend to can some peaches very soon."

—Rose Technic

* * *

Mo: Why does an old maid have seven buttons on her sweater?

Jo: I don't know.

Mo: Because she can't fascinate.

* * *

Zoo Visitor: "Where are the monkeys?"

Keeper: "They're in the back making love."

Visitor: "Will they come out for peanuts?"

Keeper: "Would you?"

* * *

Warden: What made you beat up your cell-mate the way you did?

Convict: Aw, dat guy gits wise wit me.

Warden: What's he done now?

Convict: Tore da leaf off da calendar and it was my toin.

* * *

Doctor: "You must refrain from all forms of mental exertion."

Patient: "But, doctor, I edit the stress and strain column of the "Engineer".

Doctor: "Oh, you can go ahead with that."

* * *

"I'll give you five dollars if you'll let me paint you," said the artist. The old mountaineer shifted his legs from one position to the other and back again.

"It's easy money," said the artist.

"Thar hain't no question 'bout thet," the mountaineer replied. "I was jes' a-wonderin' how I'd git the paint off afterward!"

"What am I arrested for?" asked the corrupt voter.

"You are charged," said the officer who was entering the arrest in the stationhouse ledger, "with having voted eight times."

"Charged, hey?" muttered the prisoner. "That's plenty queer. I expected to be paid for it."

* * *

In Washington they tell the story of a golfing clergyman who was badly beaten on the links by a parishioner 30 years his senior, and had returned to the club-house rather disgruntled.

"Cheer up," his opponent said, "remember, you will win at the finish. You'll probably be burying me some day."

"Even then," said the preacher, "it will be your hole."

* * *

Two Irishmen fresh from the Emerald Isle had just landed in New York and engaged a room on the top floor of a hotel. Mike, being very sleepy, threw himself on the bed and was soon fast asleep. The sights were so new and strange to Pat that he sat at the window looking out. Soon a fire alarm was sent in, and a fire engine rushed by, throwing up sparks of fire and clouds of smoke. This greatly excited Pat who called to his comrade to get up and come to the window, but Mike was sound asleep. Another engine soon followed, spouting fire and smoke like the first. This was too much for Pat and he rushed excitedly to the bedside and shaking his friend shouted, "Mike, Mike, wake up! They're moving Hell and two loads have gone by already."

—Kansas Engineer

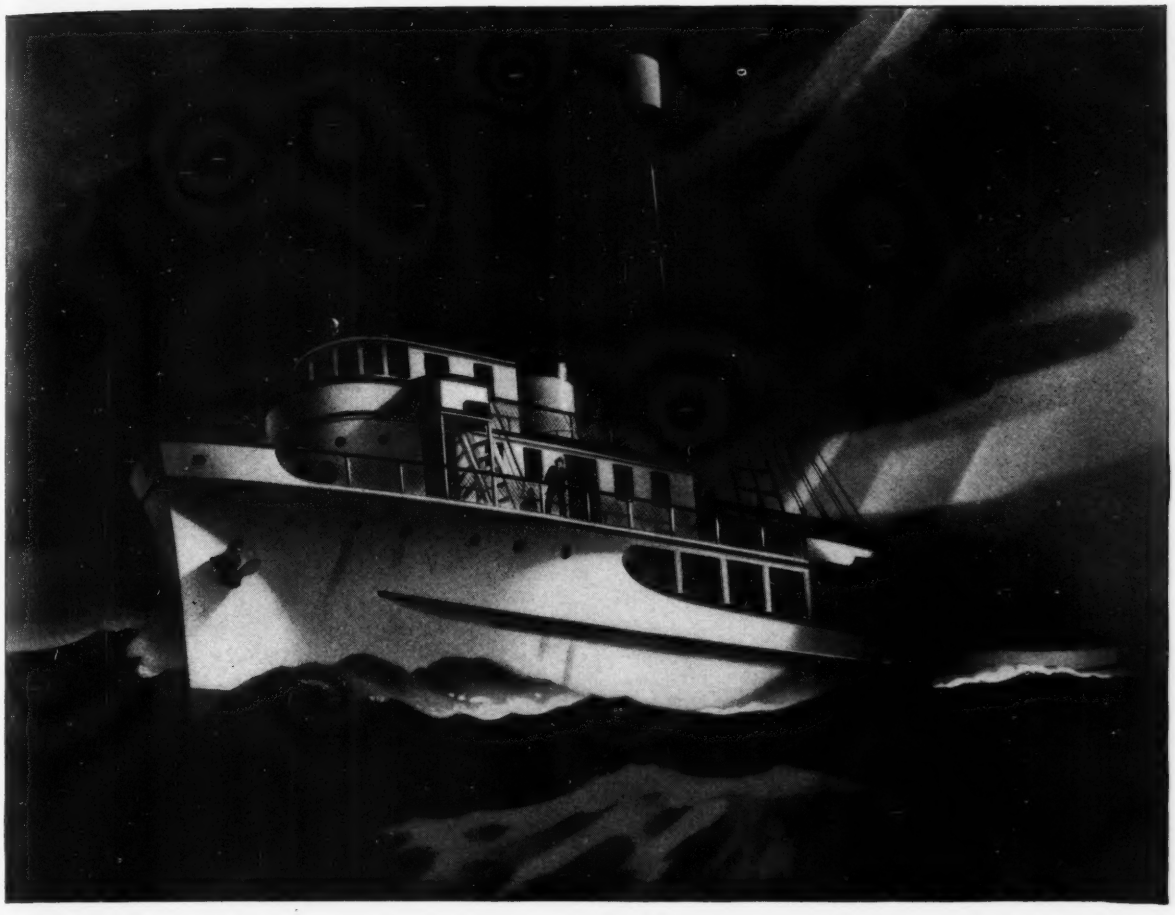
* * *

Tourist Guide: "We are passing the oldest rum house in New England."

Cornell Student Tourist: "Why?"

* * *

There's a new novel about Venetian blinds that has just been published, entitled the "Drapes of Lath".



4140 GOES TO SEA

It is well for all concerned that builders of marine Diesels make performance capacity the primary basis for the selection of materials. Breakdowns at sea or anywhere else are no fun for anyone, including the engine builder.

But the demand for reliability can be met and production costs still kept where they should be. One prominent builder, for example, is doing both by specifying Chromium-Molybdenum (SAE 4140) steel for a number of parts including bolts, wrist-pins, cylinder head studs, gears, tappets and crankshafts.

The fact that this steel can be treated to develop the properties necessary for applications having such different requirements is of value to both builder and user. It simplifies heat treatment and stockroom procedures. And, since simplification makes for uniform quality in the finished parts, it gives added assurance of dependability.

You will find complete data on this and other molybdenum steels in our book "Molybdenum in Steel," which will be sent free on request to all technical students interested in modern materials for modern needs.

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G-E Campus News

MICROANALYSIS

IN ordinary chemical analysis, where material is plentiful, the work is done on a scale most suitable for obtaining the results sought. Samples are relatively abundant; they may be used prodigally.

Not always, however, is the material for test so plentiful. The General Electric Research Laboratory at Schenectady, N. Y., handles the exceptions with its facilities for "microchemistry," in which the amount of test material available controls both the scale of operations and the strategy of attack. Micro-analyst Charles Van Brunt, Harvard, '92, of the laboratory staff is prepared to test material whose limit in smallness is set only by the refinements of manipulation attainable under the microscope with the aid of a "micromanipulator."

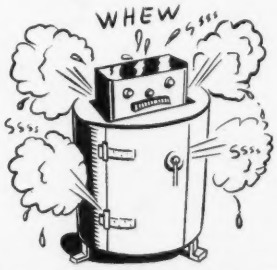
Seldom does Van Brunt attempt to identify or classify materials in solution volumes less than a cubic millimeter (about the size of a pinhead). But to analyze an ordinary drop, as delivered from a medicine dropper, is comparatively coarse work for him—near the upper limit of the true microchemical range.

FROZEN LIGHT

THE "late" Baron Munchausen was accredited (by himself) with incredible feats among which was freezing the ring of a bell. Recently, however, General Electric Research Laboratory scientists at Schenectady, N. Y., outdid the Baron by freezing light.

In producing this frozen light, G-E scientists submerged fluorescent plates in a large thermos bottle of liquid air with a temperature of 320 degrees below zero. The bottle and the plates were then bombarded by x-rays, exciting the atoms of fluorescent material on the plates literally freezing them stiff. When the plates were removed and allowed to warm up, they glowed with all the colors of the rainbow.

A "bottle" of frozen light was sent to East Orange, N. J., where it was unveiled in connection with the ceremonies marking the premiere of the motion picture, "Edison, The Man."



RADIO TURKISH BATH

RATS and moisture seem to be the two chief enemies of radio sets in the tropics. A letter from the Belgian Congo testifies to the rats; the evidence for the humidity is already ample. Except for recommending traps, there is little the General Electric Company can do about the rats, but the study of humidity is right up its alley since G-E engineers at Bridgeport, Conn., have built a humidity chamber capable of reproducing the weather conditions of the tropics.

Lamps under water tanks provide humidity by vaporization, and generate enough heat to maintain a temperature of about 100 F. Humidity and temperature are controlled by time clocks outside the sealed chamber, while uniform weather conditions are maintained within the chamber by circulating fans.

Radio receivers placed in this room are continuously subjected to conditions far more severe than those of the tropics until failures occur in the sets. In this way, young engineering college graduates enrolled in the G-E Test Course gather data which contribute to the improvement of radio, not only in the tropics, but everywhere that radios are used.

GENERAL ELECTRIC

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